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The Kelkar Education Trust's
V G Vaze College of Arts, Science and Commerce
(Autonomous)

Syllabus for M.Sc.-I.T.

(June 2020 Onwards)

Programme: M.Sc.

Semester I & II

Subject :Information Technology

Course Code	Course Title	Credits
PSIT101	Research in Computing	4
PSIT102	Data Science	4
PSIT103	Cloud Computing	4
PSIT104	Soft Computing Techniques	4
PSITP101	Research in Computing Practical	2
PSITP102	Data Science Practical	2
PSITP103	Cloud Computing Practical	2
PSITP104	Soft Computing Techniques Practical	2
	Total Credits	**24**

Course Code	Course Title	Credits
PSIT201	Big Data Analytics	4
PSIT202	Modern Networking	4
PSIT203	Microservices Architecture	4
PSIT204	Image Processing	4
PSITP201	Big Data Analytics Practical	2
PSITP202	Modern Networking Practical	2
PSITP203	Microservices Architecture Practical	2
PSITP204	Image Processing Practical	2
	Total Credits	**24**

SEMESTER I

M. Sc (Information Technology)		Semester – I	
Course Name: Research in Computing		Course Code: PSIT101	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	4	
		Hours	Marks
Evaluation System	Theory Examination	2½	60
	Theory Internal	--	40

Prerequisite: **Basic knowledge of statistical methods. Analytical and logical thinking.**

Course Objective
To make Learner
1. To be able to conduct business research with an understanding of all the latesttheories.
2. To develop the ability to explore research techniques used for solving any real world or innovateproblem.
3. Aware of various research methods and data collection techniques.
4. Understand the concept of measurement, sampling and field work.
5. Understand the concept of data analysis and presentation.

Unit	Details	Lectures
I	**Introduction:** Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues	12
II	**Beginning Stages of Research Process:** Problem definition, Qualitative research tools, Secondary dataresearch	12
III	**Research Methods and Data Collection:** Survey research, communicating with respondents, Observation methods, Experimental research	12
IV	**Measurement Concepts, Sampling and Field work:** Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size	12
V	**Data Analysis and Presentation:** Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis.	12

Course Outcome	
Learner will be able to	
CO1	Solve real world problems with scientific approach. Develop analytical skills by applying scientific methods.
CO2	Recognize, understand and apply the language, theory and models of the field of business analytics.
CO3	Foster an ability to critically analyze, synthesize and solve complex unstructured business problems.
CO4	Understand and critically apply the concepts and methods of business analytics.
CO5	Identify, model and solve decision problems in different settings interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity.
CO6	Create viable solutions to decision makingproblems.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Business Research Methods	William G.Zikmund, B.J Babin, J.C. Carr,	Cengage	8e	2016
		Atanu Adhikari, M.Griffin			
2.	Business Analytics	Albright Winston	Cengage	5e	2015
3.	Research Methods for Business Students Fifth Edition	Mark Saunders			2011
4.	Multivariate Data Analysis	Hair	Pearson	7e	2014

M. Sc (Information Technology)		Semester – I	
Course Name: Research in Computing Practical		Course Code: PSITP101	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	2	
		Hours	Marks
Evaluation System	Practical Examination	2	40

Practical No.		Name of the Practical
1	A	Write a program for obtaining descriptive statistics of data.
	B	Import data from different data sources (from Excel, csv, mysql, sql server, oracle to R/Python/Excel)
2	A	Design a survey form for a given case study, collect primary data and analyze it
	B	Perform suitable analysis of given secondary data.
3	A	Perform testing of hypothesis using one sample t-test.
	B	Perform testing of hypothesis using two sample t-test.
	C	Perform testing of hypothesis using paired t-test.
4	A	Perform testing of hypothesis using chi-squared goodness-of-fit test.
	B	Perform testing of hypothesis using chi-squared Test of Independence
5		Perform testing of hypothesis using Z-test.
6	A	Perform testing of hypothesis using one-way ANOVA.
	B	Perform testing of hypothesis using two-way ANOVA.
	C	Perform testing of hypothesis using multivariate ANOVA (MANOVA).
7	A	Perform the Random sampling for the given data and analyse it.
	B	Perform the Stratified sampling for the given data and analyse it.
8		Compute different types of correlation.
9	A	Perform linear regression for prediction.
	B	Perform polynomial regression for prediction.
10	A	Perform multiple linear regression.
	B	Perform Logistic regression.

M. Sc (Information Technology)		Semester – I	
Course Name: Data Science		**Course Code: PSIT102**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Prerequisite: **Basic understanding of statistics**

Course Objective
To make learner understand and use
1. Developindepthunderstandingofthekeytechnologiesindatascience and business analytics: data mining, machine learning, visualization techniques, predictive modelling, andstatistics.
2. Practice problem analysis and decision-making.
3. Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.
4. Concept of data science technology stack, layered framework
5. Working of various layers (Business, Utility, management) and supersteps (retrieve, access, process, transform, organize and report).

Unit	Details	Lectures
I	**Data Science Technology Stack:** Rapid Information Factory Ecosystem, Data Science Storage Tools, Data Lake, Data Vault, Data Warehouse Bus Matrix, Data Science Processing Tools ,Spark, Mesos, Akka,Cassandra,Kafka,ElasticSearch,R,Scala,Python,MQTT,The Future **Layered Framework:** Definition of Data Science Framework, Cross-Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering	**12**
II	**Business Layer:** Business Layer, Engineering a Practical Business Layer **Utility Layer:** Basic Utility Design, Engineering a Practical Utility Layer	**12**

	Three Management Layers: Operational Management Layer, Processing-Stream Definition and Management, Audit, Balance, and Control Layer, Balance, Control, Yoke Solution, Cause-and-Effect, Analysis System, Functional Layer, Data Science Process **Retrieve Superstep :** Data Lakes, Data Swamps, Training the Trainer Model, Understanding the Business Dynamics of the Data Lake, Actionable Business Knowledge from Data Lakes, Engineering a Practical Retrieve Superstep, Connecting to Other Data Sources,	
III	**Assess Superstep:** Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep,	**12**
IV	**Process Superstep :** Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science, **Transform Superstep :** Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test.	**12**
V	**Transform Superstep:** Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Linear Regression, Logistic Regression, Clustering Techniques, ANOVA, Principal Component Analysis (PCA), Decision Trees, Support Vector Machines, Networks, Clusters, and Grids, Data Mining, Pattern Recognition, Machine Learning, Bagging Data,Random Forests, Computer Vision (CV) , Natural Language Processing (NLP), Neural Networks, TensorFlow. **Organize and Report Supersteps :** Organize Superstep, Report Superstep, Graphics, Pictures, Showing the Difference	**12**

Course Outcome	
Learner will be able to	
CO1	Apply quantitative modelling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualizationtechniques.
CO2	Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, andprivacy.
CO3	Apply ethical practices in everyday business activities and make well- reasoned ethical business and data managementdecisions.
CO4	Demonstrate knowledge of statistical data analysis techniques utilized in business decisionmaking.
CO5	Apply principles of Data Science to the analysis of businessproblems.
CO6	Use data mining software to solve real-worldproblems.
CO7	Employ cutting edge tools and technologies to analyze BigData.
CO8	Apply algorithms to build machineintelligence.
CO9	Demonstrate use of team work, leadership skills, decision making and organizationtheory.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Practical Data Science	Andreas François Vermeulen	APress		2018
2.	Principles of Data Science	Sinan Ozdemir	PACKT		2016
3.	Data Science from Scratch	Joel Grus	O'Reilly		2015
4.	Data Science from Scratch first Principle in python	Joel Grus	Shroff Publishers		2017
5.	Experimental Design in Data science with Least Resources	N C Das	Shroff Publishers		2018

M. Sc (Information Technology)		Semester – I	
Course Name: Data Science Practical		Course Code: PSITP102	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	2	
		Hours	Marks
Evaluation System	Practical Examination	2	40

Practical No.	Name of the Practical
	Prerequisites to Data Science Practical.
1	Creating Data Model using Cassandra.
2	**Conversion from different formats to HOURS format.**
A.	Text delimited csv format.
B.	XML
C.	JSON
D.	MySQL Database
E.	Picture (JPEG)
F.	Video
G.	Audio
3	**Utilities and Auditing**
4	**Retrieving Data**
5	**Assessing Data**
6	**Processing Data**
7	**Transforming Data**
8	**Organizing Data**
9	**Generating Reports**
10	**Data Visualization with Power BI**

M. Sc (Information Technology)		Semester – I	
Course Name: Cloud Computing		**Course Code: PSIT103**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Course Objective
To make learner understand and use
1. To learn how to use Cloud Services.
2. To implement Virtualization, Task Scheduling algorithms.
3. Apply Map-Reduce concept to applications.
4. To build Private Cloud.
5. Broadly educate to know the impact of engineering on legal and societal issues involved.

Unit	Details	Lectures
I	**Introduction to Cloud Computing:** Introduction, Historical developments,BuildingCloudComputingEnvironments, **Principlesof ParallelandDistributedComputing:**ErasofComputing,Parallelv/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. **Virtualization:** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples.LogicalNetworkPerimeter,VirtualServer,CloudStorage Device, Cloud usage monitor, Resource replication, Ready-made environment.	**12**
II	**Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. **Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **Industrial Platforms and New Developments:** Amazon Web Services, Google App Engine, Microsoft Azure.	**12**

III	**Specialized Cloud Mechanisms:** Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multidevice broker, State Management Database. **Cloud Management Mechanisms:** Remote administration system, Resource Management System, SLA Management System, Billing Management System, **Cloud Security Mechanisms:** Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images	**12**
IV	**Fundamental Cloud Architectures:** Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant StorageArchitecture. **Advanced Cloud Architectures:** Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-MetalProvisioning Architecture, Rapid Provisioning Architecture, StorageWorkload ManagementArchitecture	**12**
V	**Cloud Delivery Model Considerations:** Cloud Delivery Models: The Cloud Provider Perspective, Cloud Delivery Models: The Cloud Consumer Perspective, **Cost Metrics and Pricing Models**: Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations, **Service Quality Metrics and SLAs:** Service Quality Metrics, SLA Guidelines	**12**

Course Outcome	
Learner will be able to	
CO1	Analyze the Cloud computing setup with its vulnerabilities and applications using differentarchitectures.
CO2	Design different workflows according to requirements and apply map reduce programmingmodel.
CO3	Apply and design suitable Virtualization concept, Cloud Resource Management and design schedulingalgorithms.
CO4	Create combinatorial auctions for cloud resources and design scheduling algorithms for computingclouds
CO5	Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloudapplication.
CO6	Broadly educate to know the impact of engineering on legal and societal issues involved in addressing the security issues of cloud computing.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Mastering Cloud Computing Foundations and ApplicationsProgramming	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi	Elsevier	-	2013
2.	Cloud Computing Concepts, Technology & Architecture	Thomas Erl, Zaigham Mahmood, and Ricardo Puttini	Prentice Hall	-	2013
3.	Distributed and Cloud Computing, FromParallel Processing to the Internet of Things	Kai Hwang, Jack Dongarra, Geoffrey Fox	MK Publishers	--	2012

M. Sc (Information Technology)		Semester – I	
Course Name: Cloud Computing Practical		**Course Code: PSITP103**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	Topic
1	Write a program for implementing Client Server communication model using TCP
a	A client server based program using TCP to find if the number entered isprime.
b	A client server TCP based chatting application.
2	Write a program for implementing Client Server communication model using UDP
a	A client server based program using UDP to find if the number entered is evenor odd.
b	A client server based program using UDP to find the factorial of the enterednumber.
c	A program to implement simple calculator operations like addition,subtraction, multiplication and division.
d	A program that finds the square, square root, cube and cube root of the enterednumber.
3	A multicast Socket example
4	Write a program to show the object communication using RMI.
a	A RMI based application program to display current date and time.
b	A RMI based application program that converts digits to words, e.g. 123 willbe converted to one two three.
5	Show the implementation of web services.
6	Implement Xen virtualization and manage with Xen Center
7	Implement virtualization using VMWare ESXi Server and managing with vCenter
8	Implement Windows Hyper V virtualization
9	Develop application for Microsoft Azure.
10	Develop application for Google App Engine

M. Sc (Information Technology)		Semester – I	
Course Name: Soft Computing Techniques		**Course Code: PSIT104**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Prerequisite: **Basic concepts of Artificial Intelligence. Knowledge of Algorithms**

Course Objective
To make learner understand and use
1. Basics of soft computing.
2. Concept of artificial neural network and supervised learning network.
3. Concept of unsupervised learning network, special network, third generation network.
4. Concept of fuzzy logic, fuzzy sets, fuzzification and defuzzification.
5. Fuzzy Rule base and Approximate reasoning. Genetic algorithms, Differential Evolution Algorithm.

Unit	Details	Lectures
I	**Introduction of soft computing**, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.	**12**
II	**Artificial Neural Network**: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network. **Supervised Learning Network**: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, RadialBasisFunction,TimeDelayNetwork,FunctionalLinkNetworks, Tree NeuralNetwork. **Associative Memory Networks**: Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks.	**12**
III	**UnSupervised Learning Networks**: Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks. Special Networks: Simulated annealing, Boltzman machine, Gaussian	**12**

	Machine, Cauchy Machine, Probabilistic neural net, cascadecorrelation network, cognition network, neo-cognition network, cellular neural network, optical neuralnetwork **Third Generation Neural Networks:**Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model.	
IV	**Introduction to Fuzzy Logic**, Classical Sets and Fuzzy sets: Classical sets, Fuzzy sets. **Classical Relations and Fuzzy Relations:** Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. **Membership Function**: features of the membership functions, fuzzification, methods of membership valueassignments. **Defuzzification**: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. **Fuzzy Arithmetic and Fuzzy measures:** fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.	**12**
V	**Fuzzy Rule base and Approximate reasoning:**Fuzzy proportion, formation of rules, decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, Fuzzy logic control systems, control system design, architecture and operation of FLC system, FLC system models and applications of FLC System. **Genetic Algorithm:** Biological Background, Traditional optimization and search techniques, genetic algorithm and search space, genetic algorithm vs. traditional algorithms, basic terminologies, simplegenetic algorithm, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm, Holland classifier systems, genetic programming, advantages and limitations and applications of geneticalgorithm. **Differential Evolution Algorithm**, Hybrid soft computing techniques – neuro – fuzzy hybrid, genetic neuro-hybrid systems, geneticfuzzy hybrid and fuzzy genetic hybrid systems.	**12**

Course Outcome	
Learner will be able to	
CO1	Identify and describe soft computing techniques and their roles inbuilding intelligent machines.
CO2	Recognize the feasibility of applying a soft computing methodologyfor a particular problem.
CO3	Apply fuzzy logic and reasoning to handle uncertainty and solveengineering problems.
CO4	Apply genetic algorithms to combinatorial optimization problems.
CO5	Apply neural networks for classification and regression problems.
CO6	Effectively use existing software tools to solve real problems usinga soft computing approach.
CO7	Evaluate and compare solutions by various soft computingapproaches for a given problem.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Artificial Intelligence and Soft Computing	Anandita Das Battacharya	SPD	3rd	2018
2.	Principles of Soft computing	S.N.Sivanandam S.N.Deepa	Wiley	3rd	2019
3.	Neuro-Fuzzy and Soft Computing	J.S.R.Jang, C.T.Sun and E.Mizutani	Prentice Hallof India		2004
4.	Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications	S.Rajasekaran, G. A. Vijayalakshami	Prentice Hall of India		2004
5.	Fuzzy Logic with Engineering Applications	Timothy J.Ross	McGraw-Hill		1997
6.	Genetic Algorithms: Search, Optimization and Machine Learning	Davis E.Goldberg	Addison Wesley		1989
7.	Introduction to AI and Expert System	Dan W. Patterson	Prentice Hall of India		2009

M. Sc (Information Technology)		Semester – I	
Course Name: Soft Computing Techniques Practical		Course Code: PSITP104	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	2	
		Hours	Marks
Evaluation System	Practical Examination	2	40

Practical No	Name of the practical
1	Implement the following:
A	Design a simple linear neural network model.
B	Calculate the output of neural net using both binary and bipolar sigmoidal function.
2	Implement the following:
A	Generate AND/NOT function using McCulloch-Pitts neural net.
B	Generate XOR function using McCulloch-Pitts neural net.
3	Implement the Following
A	Write a program to implement Hebb's rule.
B	Write a program to implement of delta rule.
4	Implement the Following
A	Write a program for Back Propagation Algorithm
B	Write a program for error Backpropagation algorithm.
5.	Implement the Following
A	Write a program for Hopfield Network.
B	Write a program for Radial Basis function
6.	Implement the Following
A	Kohonen Self organizing map
B	Adaptive resonance theory
7.	Implement the Following
A	Write a program for Linear separation.
B	Write a program for Hopfield network model for associative memory
8.	Implement the Following
A	Membership and Identity Operators | in, not in,
B.	Membership and Identity Operators is, is not
9.	Implement the Following
A	Find ratios using fuzzy logic
B	Solve Tipping problem using fuzzy logic
10.	Implement the Following
A	Implementation of Simple genetic algorithm
B	Create two classes: City and Fitness using Genetic algorithm

SEMESTER II

M. Sc (Information Technology)		Semester – II	
Course Name: Big Data Analytics		**Course Code: PSIT201**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Course Objective
To make learner
1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSqlMapReduce.
3. To understand the fundamental techniques and principles in achieving bigdata analytics with scalability and streaming capability.
4. To acquire skills that will help them to solve complex real- world problems in for decision support.
5. To understand Analytical Theory and Methods.

Unit	Details	Lectures
I	Introduction to Big Data, Characteristics of Data, and Big Data Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Big data? Data Warehouse environment, Traditional Business Intelligence versus Big Data. State of Practice in Analytics, Key roles for New Big Data Ecosystems, Examples of big Data Analytics. Big Data Analytics, Introduction to big data analytics, Classificationof Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency. Data Analytics LifeCycle	**12**
II	Analytical Theory and Methods: Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Candidate Rules, Applications of Association Rules, Validation and Testing, Diagnostics, Regression, Linear Regression, Logistic Regression, Additional Regression Models.	**12**
III	Analytical Theory and Methods: Classification, Decision Trees, Naïve Bayes, Diagnostics of Classifiers, Additional Classification Methods, Time Series Analysis, Box Jenkins methodology, ARIMA Model, Additional methods. Text Analysis, Steps, Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments	**12**

IV	Data Product, Building Data Products at Scale with Hadoop, Data Science Pipeline and Hadoop Ecosystem, Operating System for Big Data, Concepts, Hadoop Architecture, Working with Distributed file system,Working with Distributed Computation,Framework for Python and Hadoop Streaming, Hadoop Streaming, MapReduce withPython, Advanced MapReduce. In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications,	**12**
V	Distributed Analysis and Patterns, Computing with Keys, Design Patterns, Last-Mile Analytics, Data Mining and Warehousing, Structured Data Queries with Hive, HBase, Data Ingestion, Importing Relational data with Sqoop, Injesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher levelAPIs.	**12**

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Course Outcome	
Learner will be able to	
CO1	Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
CO2	Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
CO3	Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
CO4	Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc
CO5	Understand the field of big data analytics.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Big Data and Analytics	Subhashini ChellappanSeema Acharya	Wiley	First	
2.	Data Analytics with Hadoop *An Introduction for Data Scientists*	*Benjamin Bengfort and Jenny Kim*	O'Reilly		2016
3.	Big Data and Hadoop	V.K Jain	Khanna Publishing	First	2018

M. Sc (Information Technology)		Semester – II	
Course Name: BigData Analytics Practical		Course Code: PSITP201	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	2	
		Hours	Marks
Evaluation System	Practical Examination	2	40

Practical No	Details
1	Install, configure and run Hadoop and HDFS ad explore HDFS.
2	Implement word count / frequency programs using MapReduce
3	Implement an MapReduce program that processes a weather dataset.
4	Implement an application that stores big data in Hbase / MongoDB and manipulate it using R / Python
5	Implement the program in practical 4 using Pig.
6	Configure the Hive and implement the application in Hive.
7	Write a program to illustrate the working of Jaql.
8	Implement the following:
a.	Implement Decision tree classification techniques
b.	Implement SVM classification techniques
9	Solve the following:
a.	REGRESSION MODEL Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtainedand rank of the student. Also check the model is fit or not. require (foreign), require(MASS).
b.	MULTIPLE REGRESSION MODEL Apply multiple regressions, if data have acontinuous independent variable. Apply on above dataset.
10	Solve the Following:
a.	CLASSIFICATION MODEL a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier.
b.	CLUSTERING MODEL a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.

M. Sc (Information Technology)		Semester – I	
Course Name: Modern Networking		**Course Code: PSIT202**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Course Objective
To make learner understand and use
1. To understand the state-of-the-art in network protocols, architectures and applications.
2. Analyze existing network protocols and networks.
3. Develop new protocols in networking.
4. To understand how networking research is done.
5. To investigate novel ideas in the area of Networking via term-long research projects.

Unit	Details	Lectures
I	Modern Networking Elements of Modern Networking The Networking Ecosystem ,Example Network Architectures, Global Network Architecture, A Typical Network HierarchyEthernet Applications of Ethernet Standards Ethernet Data RatesWi-Fi ApplicationsofWi-Fi, StandardsWi-FiDataRates4G/5GCellularFirst Generation Second Generation, Third Generation Fourth Generation Fifth Generation, Cloud Computing Cloud Computing Concepts The Benefits of Cloud Computing Cloud Networking Cloud Storage, Internet of Things Things on the Internet of Things, Evolution Layers of the Internet of Things, Network Convergence Unified Communications, Requirements and Technology Types of Network and Internet Traffic, Elastic Traffic, Inelastic Traffic, Real-Time Traffic Characteristics Demand: Big Data, Cloud Computing, and Mobile Traffic Big Data Cloud Computing, Mobile Traffic, Requirements: QoS and QoE, Quality of Service, Quality of Experience, Routing Characteristics, Packet Forwarding, Congestion Control ,Effects of Congestion, Congestion Control Techniques, SDN and NFVSoftware- Defined Networking, Network Functions Virtualization Modern Networking Elements	**12**
II	Software-Defined Networks SDN: Background and Motivation, Evolving Network Requirements Demand Is Increasing, Supply Is Increasing Traffic Patterns Are More Complex Traditional Network Architectures are Inadequate, TheSDN ApproachRequirementsSDNArchitectureCharacteristicsofSoftware-	**12**

	Defined Networking, SDN- and NFV-Related Standards Standards-Developing Organizations Industry Consortia Open Development Initiatives, SDN Data Plane and OpenFlow SDN Data Plane, Data Plane Functions Data Plane Protocols OpenFlow Logical Network DeviceFlowTableStructureFlowTablePipeline,TheUseofMultiple Tables Group Table OpenFlow Protocol, SDN ControlPlane SDN Control Plane Architecture Control Plane Functions, Southbound Interface Northbound Interface Routing, ITU-T Model, OpenDaylight OpenDaylight Architecture OpenDaylight Helium, REST REST Constraints Example REST API, Cooperation and Coordination Among Controllers, Centralized Versus Distributed Controllers, High-Availability Clusters Federated SDN Networks, Border Gateway Protocol Routing and QoS Between Domains, Using BGP for QoS Management IETF SDNi OpenDaylight SNDi SDN Application Plane SDN Application Plane Architecture Northbound Interface Network Services Abstraction Layer Network Applications, User Interface, Network Services Abstraction Layer Abstractions in SDN, Frenetic Traffic Engineering PolicyCop Measurement and Monitoring Security OpenDaylight DDoS Application Data Center Networking, Big Data over SDN Cloud Networking over SDN Mobility and Wireless Information-Centric Networking CCNx, Use of an Abstraction Layer	
III	Virtualization, Network Functions Virtualization: Concepts and Architecture, Background and Motivation for NFV, Virtual Machines The Virtual Machine Monitor, Architectural Approaches Container Virtualization, NFV Concepts Simple Example of the Use of NFV, NFV Principles High-Level NFV Framework, NFV Benefits and Requirements NFV Benefits,NFVRequirements, NFV Reference Architecture NFV Management and Orchestration, Reference Points Implementation, NFV Functionality, NFV Infrastructure,Container Interface,Deployment of NFVI Containers,Logical Structure of NFVI Domains,ComputeDomain, Hypervisor Domain,Infrastructure Network Domain, Virtualized Network Functions, VNF Interfaces,VNFC to VNFC Communication,VNF Scaling, NFV Management and Orchestration, Virtualized Infrastructure Manager Virtual Network Function Manager, NFV Orchestrator, Repositories, Element Management, OSS/BSS, NFV Use Cases Architectural Use Cases, Service-Oriented Use Cases, SDN and NFV Network Virtualization, Virtual LANs ,The Use of Virtual LANs, Defining VLANs, Communicating VLAN Membership, IEEE 802.1Q VLAN Standard, Nested VLANs, OpenFlow VLAN Support, Virtual Private Networks, IPsec VPNs, MPLS VPNs, Network Virtualization, Simplified Example, Network Virtualization Architecture, Benefits of Network Virtualization, OpenDaylight's Virtual Tenant Network, Software-DefinedInfrastructure, Software-Defined Storage, SDI Architecture	**12**

IV	Defining and Supporting User Needs, Quality of Service, Background, QoSArchitecturalFramework,DataPlane,ControlPlane,Management Plane, Integrated Services Architecture, ISAApproach ISA Components, ISA Services, Queuing Discipline, Differentiated Services, Services, DiffServ Field, DiffServ Configuration and Operation, Per-Hop Behavior, Default Forwarding PHB, ServiceLevel Agreements, IP Performance Metrics, OpenFlow QoS Support, Queue Structures, Meters, QoE: User Quality of Experience, Why QoE?,Online Video Content Delivery, Service Failures Due to Inadequate QoE Considerations QoE-Related StandardizationProjects, Definition of Quality of Experience, Definition of Quality, Definition of Experience Quality Formation Process, Definition of Quality of Experience, QoE Strategies in Practice, The QoE/QoS Layered Model Summarizing and Merging the ,QoE/QoS Layers, Factors Influencing QoE, Measurements of QoE, Subjective Assessment,Objective Assessment, End-User Device Analytics, Summarizing the QoE Measurement Methods, Applications of QoE Network Design Implications of QoS and QoE Classification of QoE/ QoS Mapping Models, Black-Box Media-Based QoS/QoE Mapping Models, Glass-Box Parameter-Based QoS/QoE Mapping Models, Gray-Box QoS/QoE Mapping Models, Tips for QoS/QoE Mapping Model Selection, IP- Oriented Parameter-Based QoS/QoE Mapping Models, Network Layer QoE/QoS Mapping Models for Video Services, Application Layer QoE/QoS Mapping Models for Video Services Actionable QoE over IP-Based Networks, The System-Oriented Actionable QoE Solution, The Service-Oriented Actionable QoE Solution, QoE Versus QoS Service Monitoring, QoS Monitoring Solutions, QoE Monitoring Solutions, QoE-Based Network and Service Management,QoE-Based Management of VoIP Calls, QoE-Based Host-Centric Vertical Handover, QoE-Based Network-Centric Vertical Handover	**12**
V	Modern Network Architecture: Clouds and Fog, Cloud Computing, Basic Concepts, Cloud Services, Software as a Service, Platform as a Service,InfrastructureasaService,OtherCloudServices,XaaS,Cloud Deployment Models, Public Cloud Private Cloud Community Cloud, Hybrid Cloud, Cloud Architecture, NIST Cloud Computing Reference Architecture, ITU-T Cloud Computing Reference Architecture, SDN and NFV, Service Provider Perspective Private Cloud Perspective, ITU-T Cloud Computing Functional Reference Architecture, The Internet of Things: Components The IoT Era Begins, The Scope of the Internet of Things Components of IoT-Enabled Things, Sensors, Actuators, Microcontrollers, Transceivers, RFID, The Internet of Things: Architecture and Implementation, IoT Architecture, ITU-T IoT Reference Model, IoT World Forum Reference Model, IoT Implementation, IoTivity, Cisco IoT System, ioBridge, Security Security Requirements, SDN Security Threats to SDN, Software-	**12**

	Defined Security, NFV Security, Attack Surfaces, ETSI Security Perspective, Security Techniques, Cloud Security, Security Issues and Concerns, Cloud Security Risks and Countermeasures, DataProtection in the Cloud, Cloud Security as a Service, Addressing Cloud Computer Security Concerns, IoT Security, The Patching Vulnerability, IoT Security and Privacy Requirements Defined by ITU-T An IoT Security Framework, Conclusion	

Course Outcome	
Learner will be able to	
CO1	Demonstrate in-depth knowledge in the area of Computer Networking.
CO2	Demonstrate scholarship of knowledge through performing in a group to identify, formulate and solve a problem related to Computer Networks
CO3	Prepare a technical document for the identified Networking System
CO4	Conducting experiments to analyze the identified research work in building Computer Networks
CO5	Understand the research in networking.

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud	William Stallings	Addison-Wesley Professional		October 2015
2.	SDN and NFV Simplified A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization	**Jim Doherty**	Pearson Education, Inc		
3.	Network Functions Virtualization (NFV) with a Touch of SDN	Rajendra Chayapathi Syed Farrukh Hassan	Addison-Wesley		
4.	CCIE and CCDE Evolving Technologies Study Guide	Brad dgeworth, Jason Gooley, Ramiro Garza Rios	Pearson Education, Inc		2019

M. Sc (Information Technology)		Semester – II	
Course Name: Modern Networking Practical		Course Code: PSITP202	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	2	
		Hours	Marks
Evaluation System	Practical Examination	2	40

Practical No	Details
1	Configure IP SLA Tracking and Path Control Topology
2	Using the AS_PATH Attribute
3	Configuring IBGP and EBGP Sessions, Local Preference, and MED
4	Secure the Management Plane
5	Configure and Verify Path Control Using PBR
6	IP Service Level Agreements and Remote SPAN in a Campus Environment
7	Inter-VLAN Routing
8	Simulating MPLS environment
9	Simulating VRF
10	Simulating SDN with OpenDaylight SDN Controller with the Mininet NetworkEmulator OFNet SDN networkemulator
11	Simulating OpenFlow Using MININET

All practical are expected to be performed on GNS3/EVE-Ng network Emulator/MININET

M. Sc (Information Technology)		Semester – I	
Course Name: Microservice Architecture		**Course Code: PSIT203**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Course Objective
To make learner understand and use
1. Gain a thorough understanding of the philosophy and architecture of Web applications using ASP.NET Core MVC
2. Gain a practical understanding of.NET Core.
3. Acquire a working knowledge of Web application development using ASP.NET Core MVC 6 and Visual Studio.
4. Persist data with XML Serialization and ADO.NET with SQL Server Create HTTP services using ASP.NET Core Web API.
5. Deploy ASP.NET Core MVC applications to the Windows Azure cloud.

Unit	Details	Lectures
I	**Microservices:** Understanding Microservices, Adopting Microservices, The Microservices Way. **Microservices Value Proposition:** Deriving Business Value, defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach. **Designing Microservice Systems:** The Systems Approach to Microservices, A Microservices Design Process, **Establishing a Foundation:** Goals and Principles, Platforms,Culture.	**12**
II	**Service Design:** Microservice Boundaries, API design for Microservices, Data and Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Microservices, dealing with Dependencies, **System Design and Operations:** Independent Deployability, More Servers, Docker and Microservices, Role of ServiceDiscovery,NeedforanAPIGateway,MonitoringandAlerting. **AdoptingMicroservicesinPractice:**SolutionArchitectureGuidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance.	12

III	**Building Microservices with ASP.NET Core:** Introduction, Installing .NET Core, Building a Console App, Building ASP.NET Core App. **Delivering Continuously:** Introduction to Docker, Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to Dicker Hub. **Building Microservice with ASP.NETCore:**Microservice,TeamService,APIFirstDevelopment, Test First Controller, Creating a CI pipeline, Integration Testing, Running the team service Docker Image. **BackingServices:** Microservices Ecosystems, Building the location Service, Enhancing Team Service.	**12**
IV	**Creating Data Service:** Choosing a Data Store**,** Building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories, Exercise the Data Service. **Event Sourcing and CQRS:** Event Sourcing, CQRS pattern, Event Sourcing and CQRS, Running the samples. **Building an ASP.NET Core Web Application:** ASP.NET Core Basics, Building Cloud-Native Web Applications. **Service Discovery:** Cloud Native Factors, Netflix Eureka,Discovering andAdvertisingASP.NETCoreServices.DNSandPlatformSupported Discovery.	**12**
V	**Configuring Microservice Ecosystems:** Using Environment VariableswithDocker,UsingSpringCloudConfigServer,Configuring Microservices with etc., **Securing Applications and Microservices:** Security in the Cloud, Securing ASP.NET Core Web Apps, Securing ASP.NET Core Microservices. **Building Real-Time Appsand Services:** Real-Time Applications Defined, Websockets in the Cloud, Using a Cloud Messaging Provider, Building the ProximityMonitor. **Putting It All Together:** Identifying and Fixing Anti-Patterns, Continuing the Debate over Composite Microservices, The Future.	**12**

Course Outcome	
Learner will be able to	
CO1	Develop web applications using Model View Control.
CO2	Create MVC Models and write code that implements business logic within Model methods, properties, and events.
CO3	Create Views in an MVC application that display and edit data and interact with Models and Controllers.
CO4	Gaining a thorough understanding of the philosophy and architecture of .NET Core.
CO5	Understanding packages, metapackages and frameworks.
CO6	Acquiring a working knowledge of the .NET programming model.
CO7	Implementing multi-threading effectively in .NET applications.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Microservice Architecture: *Aligning Principles, Practices, andCulture*	Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike Amundsen	O'Reilly	First	2016
2.	Building Microservices with ASP.NET Core	Kevin Hoffman	O'Reilly	First	2017
3.	Building Microservices: Designing Fine-Grained Systems	Sam Newman	O'Reilly	First	
4.	Production-ready Microservices	Susan J. Fowler	O'Reilly		2016

M. Sc (Information Technology)		Semester – II	
Course Name: Microservices Architecture Practical		Course Code: PSITP203	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	2	
		Hours	Marks
Evaluation System	Practical Examination	2	40

Practical No	Details
1	Building APT.NET Core MVC Application.
2	Building ASP.NET Core REST API.
3	Working with Docker, Docker Commands, Docker Images and Containers
4	Installing software packages on Docker, Working with Docker Volumes and Networks.
5	Working with Docker Swarm.
6	Working with Circle CI for continuous integration.
7	Creating Microservice with ASP.NET Core.
8	Working with Kubernetes.
9	Creating Backing Service with ASP.NET Core.
10	Building real-time Microservice with ASP.NET Core.

Practical can be done with VS2017, VS2019, Visual Code with ASP.NET Core 3.1.x installed along with Docker and Docker Desktop.

M. Sc (Information Technology)		Semester – II	
Course Name: Image Processing		Course Code: PSIT204	
Periods per week 1 Period is 60 minutes	Lectures	4	
	Credits	4	
		Hours	Marks
Evaluation System	Theory Examination	2½	60
	Theory Internal	--	40

Course Objective
To make learner
1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.
5. Interpret Image compression standards.
6. Interpret image segmentation and representation techniques.

Unit	Details	Lectures
I	**Introduction:**DigitalImageProcessing,OriginsofDigitalImageProcessing, Applications and Examples of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, **Digital Image Fundamentals:** Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Basic Mathematical Tools Used in Digital Image Processing, **Intensity Transformations and Spatial Filtering:** Basics, Basic Intensity Transformation Functions, Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass)SpatialFilters,Highpass,Bandreject,andBandpassFiltersfrom Lowpass Filters, Combining Spatial Enhancement Methods, UsingFuzzy Techniques for Intensity Transformations and SpatialFiltering	12
II	**Filtering in the Frequency Domain:** Background, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Properties of the 2-D DFT and IDFT, Basics of Filtering in the Frequency Domain, Image Smoothing Using Lowpass Frequency Domain Filters, Image Sharpening Using Highpass Filters, Selective Filtering, Fast Fourier Transform **Image Restoration and Reconstruction:** A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-----Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections	12

III	**Wavelet and Other Image Transforms:** Preliminaries, Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms **Color Image Processing:** Color Fundamentals, Color Models, Pseudocolor Image Processing, Full-Color Image Processing, Color Transformations, ColorImageSmoothingandSharpening,UsingColorinImageSegmentation, Noise in Color Images, Color ImageCompression. **Image Compression and Watermarking:** Fundamentals, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Symbol-based Coding, 8 Bit-plane Coding, Block TransformCoding, Predictive Coding, Wavelet Coding, Digital ImageWatermarking,	**12**
IV	**Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Morphological Algorithms, Morphological Reconstruction, Morphological Operations on Binary Images, Grayscale Morphology **Image Segmentation I: Edge Detection, Thresholding, and Region Detection:** Fundamentals, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Superpixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation	**12**
V	**Image Segmentation II: Active Contours: Snakes and Level Sets:** Background, Image Segmentation Using Snakes, Segmentation Using Level Sets. **Feature Extraction:** Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT)	**12**

Course Outcome	
Learner will be able to	
CO1	Understand the relevant aspects of digital image representation and their practical implications.
CO2	Have the ability to design pointwise intensity transformations to meet stated specifications.
CO3	Understand 2-D convolution, the 2-D DFT, and have the abitilty to design systems using these concepts.
CO4	Have a command of basic image restoration techniques.
CO5	Understand the role of alternative color spaces, and the design requirements leading to choices of color space.
CO6	Appreciate the utility of wavelet decompositions and their role in image processing systems.
CO7	Have an understanding of the underlying mechanisms of image compression, and the ability to design systems using standard algorithms to meet design specifications.

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Digital Image Processing	Gonzalez and Woods	Pearson/Prentice Hall	Fourth	2018
2.	Fundamentals of Digital Image Processing	A K. Jain	PHI		
3.	The Image Processing Handbook	J. C. Russ	CRC	Fifth	2010

M. Sc (Information Technology)		Semester – II	
Course Name: Image Processing Practical		**Course Code: PSITP204**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	Details
1.	Basics
a	Program to calculate number of samples required for an image.
b	Program to study the effects of reducing the spatial resolution of a digital image.
c	Program to study the effects of varying the number of intensity levels in a digital image
d	Program to perform image averaging (image addition) for noise reduction.
e	Program to compare images using subtraction for enhancing the difference between images.
f	Image Registration.
2.	Intensity transformation and Spatial Filtering
	IMAGE ENHANCEMENT
a	Basic Intensity Transformation functions
	Program to perform Imagenegation Program to perform threshold on animage. Program to perform Logtransformation Power-lawtransformations Piecewise lineartransformations a. ContrastStretching b. Gray-level slicing with and withoutbackground. c. Bit-planeslicing
b	Program to plot the histogram of an image andcategorise Program to apply histogramequalization
c	Write a program to perform convolution and correlation
d	Write a program to apply smoothing and sharpening filters on grayscale and color images LowPass HighPass Note: Use all kernels mentioned in the reference book
3.	Filtering in Frequency Domain
a	Program to apply Discrete Fourier Transform on an image
b	Program to apply Low pass and High pass filters in frequency domain
c	Program to apply Laplacian filter in frequency domain
d	Note: All other filters can be applied, studied and compared with filters in spatial domain.

e	Program for high frequency emphasis filtering, high boost and homomorphic filtering.
4.	Image Denoising
a	Program to denoise using spatial mean, median and adaptive meanfiltering
b	Program for Image deblurring using inverse, Weinerfilters
5.	Color Image Processing
a	Program to read a color image and segment into RGB planes, histogram of colorimage
b	Program for converting from one color model to anothermodel
c	Program to apply false colouring(pseudo) on a gray scaleimage
6.	Fourier Related Transforms
	Program to compute Discrete Cosine Transforms, Walsh -Hadamard Transforms, Haar Transform, Wavelet
7.	Image compression
	Program to apply compression and decompression algorithm on an image (Arithmetic, Huffman and LZW coding techniques.
8.	Morphological Image Processing
a	Program to apply erosion, dilation, opening,closing
b	Program for detecting boundary of animage
c	Program to apply Hit-or-Misstransform
d	Program to apply morphological gradient on animage
e	Program to apply Top-Hat/Bottom-hatTransformations
9.	Image Segmentation
a	Program for Edge detectionusing Sobel, Prewitt, Marr-Hildreth andCanny
b	Illustrate Watershed segmentationalgorithm
c	Any more to be included(to beconsulted)
10.	Feature Extraction
a	i. Apply Principal components for imagedescription
b	ii. Apply Harris-Stephens corner detector algorithm

All practical can be done in MATLAB / Scilab / Python
Note:
1) Useofbuilt-infunctionsformatrixoperationsandmathematicaloperationsareallowed
2) Use gray-level and color images or image matrices as input to allprograms.

Evaluation Scheme

Internal Evaluation (40 Marks)

The internal assessment marks shall be awarded as follows:

1. **30 marks (Any one of thefollowing):**
   a. **Written Test or**
   b. **SWAYAM (Advanced Course) of minimum 20 hours and certification exam completed or**
   c. **NPTEL (Advanced Course) of minimum 20 hours and certification exam completed or**
   d. **Valid International Certifications (Prometric, Pearson, Certiport,Coursera, Udemy and thelike)**
   e. **One certification marks shall be awarded one course only. For fourcourses, the students will have to complete fourcertifications.**
2. **10marks**
   The marks given out of 40 for publishing the research paper should be divided into four course and should awarded out of 10 in each of the four course.

i. **Suggested format of Question paper of 30 marks for the writtentest.**

Q1.	**Attempt *any two*of the following:**	**16**
a.		
b.		
c.		
d.		
Q2.	**Attempt *any two*of the following:**	**14**
a.		
b.		
c.		
d.		

ii. **10 marks from every course coming to a total of 40 marks, shall be awarded on publishing of research paper in UGC approved Journal with plagiarism less than 10%. The marks can be awarded as per the impact factor of the journal, qualityof the paper, importance of the contents published, socialvalue.**

External Examination: (60 marks)

	All questions are compulsory	
Q1	**(Based on Unit 1) Attempt *any two*of the following:**	**12**
a.		
b.		
c.		
d.		
Q2	**(Based on Unit 2) Attempt *any two*of the following:**	**12**
Q3	**(Based on Unit 3) Attempt *any two*of the following:**	**12**
Q4	**(Based on Unit 4) Attempt *any two*of the following:**	**12**
Q5	**(Based on Unit 5) Attempt *any two*of the following:**	**12**

Practical Evaluation (50 marks)

A Certified copy journal is essential to appear for the practical examination.

1.	**Practical Question 1**	**20**
2.	**Practical Question 2**	**20**
3.	**Journal**	**5**
4.	**Viva Voce**	**5**

OR

1.	**Practical Question**	**40**
2.	**Journal**	**5**
3.	**Viva Voce**	**5**

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